Breast-feeding, nutritional status, and other prognostic factors for dehydration among young children with diarrhoea in Brazil

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Early identification of children at high risk of diarrhoea-associated dehydration would be of great value to health care workers in developing countries. To identify prognostic factors for life-threatening dehydration, we carried out a case–control study among under-2-year-olds in Porto Alegre, Brazil. Cases were 192 children admitted to hospital with moderate or severe dehydration, while controls were children matched to controls by neighbourhood and age, who experienced nondehydrating diarrhoea in the week preceding the interview.

The following variables were significantly associated with an increased risk of dehydration, after adjustment for age and other confounding variables: absence of the father from the home; low paternal education level; young age; maternal age 25–29 years or <20 years; mother of mixed race; high birth order; short birth interval; low birth weight; stunting, underweight and wasting; lack of breast-feeding; presence of other under-5-year-olds in the home; families with 4–5 members; lack of antenatal care; less than three doses of diphtheria–pertussis–tetanus or poliomyelitis vaccine; previous admission to hospital; use of medicines during the fortnight prior to the episode; and living in an unclean home. The associations were particularly strong (P<0.001) for the child's age, birth weight and other anthropometric indicators, birth interval, and feeding mode. In terms of their sensitivity and specificity, however, these prognostic factors were not as effective as early signs and symptoms for predicting the outcome of the episode.

Introduction

Although there may be up to 1000 million episodes of diarrhoea each year among under-5-year-olds in developing countries (*1*), not more than 2–3% of these will eventually lead to life-threatening dehydration (*2*). The early identification of children at a higher risk of developing diarrhoea-associated dehydration would be useful because health workers could keep such children under close surveillance when they suffer diarrhoea and preventive strategies could be designed to alter the prognostic factors.

One approach for identifying high-risk children is to examine the clinical presentation of the diarrhoea episode in order to identify the early signs and symptoms associated with the risk of dehydration (*3*). Alternatively, other characteristics of the child and his/her family can be identified—including socioeconomic, biological, demographic, anthropometric, dietary, and health-care-related variables—which may be associated with a poor prognosis. Compared with the use of signs and symptoms (which are only present after the onset of the episode) the second approach has the advantage that the characteristics involved can be identified before high-risk children present with diarrhoea.

Theoretically, a prospective study would be ideal for investigating the prognostic factors of dehydrating diarrhoea: children would be identified at an early stage of the episode and then followed up. This approach, however, has two serious drawbacks: firstly, it would be unethical to withhold oral rehydration therapy from any child with diarrhoea; and secondly (since the incidence of moderate-to-severe dehydration is low) a very large number of children would have to be included in the study.

These disadvantages can be averted by using a case–control study design. In this approach, children with moderate-to-severe dehydration as a consequence of diarrhoea can be compared with those with self-limiting episodes. Here, we describe the results of such a study, which was carried out in an urban area of Brazil.

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Methods

The study was carried out in the metropolitan area of Porto Alegre in southern Brazil (population 2.5 million) during the main diarrhoea season (December 1987 to April 1988). The city's infant mortality rate was approximately 30 per 1000, although there was a wide variation, and rates of over 100 per 1000 were observed in slum areas.

Cases were children aged 0–23 months who were recruited from the two largest paediatric hospitals in the city, which cater for the low-income sector of the population. The children had been admitted with diarrhoea of less than 8 days' duration, accompanied by moderate or severe dehydration, defined as a persistent skinfold plus at least one of the following signs: sunken fontanelle, dry mouth and tongue, sunken eyes, reduced urinary output, weak pulse, and a sleepy or irritable condition.[a] Selection was restricted to those aged 0–23 months, because they are the most vulnerable age group both for morbidity and mortality (*1*). All 184 children who satisfied these conditions were included; 16 other children were also included who had not been examined for skin turgor, either because they were too ill or because they were admitted to hospital at the weekend or during the night, but who experienced a weight gain of 5% or more after rehydration.

One neighbourhood control was matched to each case. For this purpose, the child was selected who lived nearest to the case's home, was within the same broad age range as the case (0–11 or 12–23 months), and who exhibited a diarrhoea episode that started during the 7 days preceding the interview.

Data were collected by interviewing the children's mothers or carers on a number of socioeconomic, biological, dietary, demographic, health care and morbidity variables (see Table 1). Information on environmental variables was obtained by observing the homes concerned. Children were weighed naked using portable spring scales that were calibrated daily. Cases were only weighed after they had been completely rehydrated. AHRTAG baby-length measurers were used to determine lengths. Information on birth weight was collected from the birth card or by recall (an earlier study in the area showed that information collected in this way was reliable (*4*)).

Cases and controls were compared using a logistic regression analysis for matched studies (*5*). After obtaining frequency tabulations, we calculated crude estimates of the odds ratios. Age-adjusted odds ratios were determined for variables that changed with age (type of feeding, nutritional status, presence of under-5-year-olds, vaccine status, previous hospitalizations, and use of medicines). For adjustment purposes, age was coded into the following categories: 0–1, 2–3, 4–5, 6–8, 9–11, 12–17, and 18–23 months.

Those variables which were significant ($P < 0.05$) or nearly significant ($P < 0.1$) in the crude or age-adjusted analysis were also adjusted for the presence/schooling of the father, which was the only prognostic factor among the socioeconomic variables.

The positive predictive value of the variables was calculated by assuming that 3% of episodes led to moderate or severe dehydration.

Results

A total of 200 cases were selected, of whom eight (4%) could not be studied because their parents were unavailable for interview. One neighbourhood control was selected for each of the remaining 192 cases. In seven instances (4%), it was not possible to interview the first control identified, and these controls were therefore replaced by their next-nearest neighbours who satisfied the study criteria.

Table 1 summarizes the associations between prognostic factors and the risk of dehydration. For ease of presentation, the variables were divided into the following categories: socioeconomic, biological, anthropometric, dietary, environmental, health care utilization, and morbidity history. Table 1 shows the complete set of variables studied, and Tables 2 to 6 include further information about the most relevant prognostic factors for dehydration.

Since cases and controls were matched by neighbourhood, the study of socioeconomic differentials (Table 1) may have been affected by overmatching (*6*). The only such variable associated with dehydration was the presence/schooling of the father; compared with children whose father had had ≥5 years of schooling, those who did not live with their father had a twofold increase in risk, and those whose fathers had had no schooling exhibited a threefold increase. Family income, and maternal education and employment were not associated with the risk of dehydration.

Several of the biological variables were associated with the prognosis of the episode (Tables 1 and 2). The risk of dehydration decreased sharply with age and was approximately twenty times greater in the first 2 months of life than in the period 9–11 months. There was no significant variation in the risk with age during the second year of life (data for these children were analysed separately from those for infants, since stratification for age was used to sample the controls). However, the lower risk of

[a] **Kirkwood, B.** *Guidelines for the preparation of protocols to study risk factors for life-threatening diarrhoea, using case–control methodology.* (Unpublished document).

Table 1: **Summary of the findings on prognostic factors for diarrhoea-associated dehydration, Porto Alegre, Brazil, 1988**

Variables	Type of analysis [a]: Crude or age-adjusted	Type of analysis [a]: Adjusted also for father's presence/education level
Socioeconomic		
Maternal schooling	♦	♦
Presence/schooling of the father	**	
Maternal employment	♦	
Monthly family income	♦	
Biological		
Age	***	
Sex	♦	
Maternal age	*	*
Maternal race	***	**
Birth order	**	**
Birth interval	***	***
Previous child deaths	♦	
Type of delivery	♦	
Twin/singleton	♦	
Anthropometric		
Birth weight	***	***
Height-for-age	***	***
Weight-for-age	***	***
Weight-for-length	***	***
Dietary		
Type of milk consumed	**	**
Feeding mode	***	***
Environmental characteristics		
Other under-5-year-olds	**	*
Children aged 5–12 years	♦	
Presence of grandparents	♦	
Family size	*	*
Type of building	**	?
No. of rooms	♦	
No. of bedrooms	♦	
Use of refrigerator	♦	
Piped water	♦	
Source of water	♦	
Type of latrine	♦	
Cleanliness of house	**	**
Health care utilization		
Antenatal care (ANC)	**	*
Month ANC was started	♦	
No. of ANC attendances	♦	
Place of birth	♦	
DPT vaccination[b]	***	**
Polio vaccination	***	**
Measles vaccination	♦	♦
No. of weighings reported	*	?
Morbidity history		
Previous hospitalizations (infections)	*	?
Other previous hospitalizations	**	*
Use of medicines in previous 2 weeks	**	**
Use of antibiotics in previous 2 weeks	♦	

[a] ♦ = no association; ? = $0.05<P<0.1$; * = $0.01<P<0.05$; ** = $0.001<P<0.01$; *** = $P<0.001$.

[b] DPT = diphtheria–pertussis–tetanus.

Table 2: **Prognostic factors (biological variables) for diarrhoea-associated dehydration, Porto Alegre, Brazil, 1988**

			Odds ratio	
Variable	No. of cases	No. of controls	Crude or age-adjusted	Adjusted also for father's presence/education
Age (months)				
0–1	30	7	1.0 [a]	—
2–3	45	27	0.3 (0.1–0.9) [b]	—
4–5	33	22	0.3 (0.1–0.8)	—
6–8	38	52	0.1 (0.05–0.4)	—
9–11	18	56	0.04 (0.01–0.1)	—
			P<0.001	
12–17	18	17	1.0 [a]	—
18–23	10	11	1.2 (0.4–3.5)	—
			P = 0.8	
Birth order				
1	36	56	1.0 [a]	1.0 [c]
2	42	44	1.4 (0.8–2.5)	1.4 (0.8–2.7)
3	42	39	1.7 (0.9–3.0)	1.8 (1.0–3.4)
≥4	71	53	2.2 (1.2–4.0)	2.1 (1.2–4.0)
			P = 0.06	P = 0.09
			P = 0.007 (trend)	P = 0.01 (trend)
Birth interval (months)				
<18	41	19	1.0 [a]	1.0 [c]
18–29	47	37	0.5 (0.2–1.2)	0.5 (0.2–1.2)
30–47	30	27	0.5 (0.2–1.2)	0.4 (0.2–1.1)
≥48	33	48	0.2 (0.09–0.5)	0.3 (0.1–0.7)
Maternal age (years)				
<20	46	38	1.0 [a]	1.0 [c]
≥20–24	48	69	0.5 (0.3–0.9)	0.5 (0.3 – 0.96)
≥25–29	47	31	1.2 (0.6–2.3)	1.4 (0.7–2.7)
≥30	49	54	0.6 (0.3–1.2)	0.7 (0.4–1.4)
			P = 0.02	P = 0.02
Maternal race				
White	90	125	1.0 [a]	1.0 [c]
Black	39	33	1.7 (0.9–3.0)	1.4 (0.8–2.6)
Mixed	51	26	3.7 (1.9–7.1)	3.3 (1.6–6.7)
			P<0.001	P = 0.003

[a] Crude.
[b] Figures in parentheses are the 95% confidence intervals.
[c] Adjusted for father's presence/education level.

dehydration in the second year of life may be inferred from the much smaller number of dehydrated 1-year-olds (28) than of infants (164), although another Brazilian study has reported similar incidences of diarrhoea for these two age groups (*7*).

Higher birth orders were associated with greater risks, since children with three or more older siblings were twice as likely as firstborns to become dehydrated. Table 2 also shows that the risk of dehydration for children born within 18 months of their next-eldest sibling was three times greater than that for children born after an interval of ≥4 years.

Although maternal age was significantly associated with the risk of dehydration, there was no clear pattern, with the highest risks being among women aged 25–29 years and adolescents. Maternal race was also associated with the risk of dehydration—children whose mothers were mulattos being three times more likely to become dehydrated.

The occurrence of previous child deaths in the family was not associated with the risk of dehydration, nor was the type of delivery. Although twins appeared to have twice the risk of singletons, this difference was not significant (P = 0.13), perhaps

Table 3: **Prognostic factors (anthropometric variables) for diarrhoea-associated dehydration, Porto Alegre, Brazil, 1988**

Variable	No. of cases	No. of controls	Odds ratio: Crude or age-adjusted	Odds ratio: Adjusted also for father's presence/education
Birth weight (g)				
<2500	46	17	1.0 [a]	1.0 [c]
>2500	43	42	0.4 (0.2–0.8)[b]	0.4 (0.2–0.8)
>3000	55	68	0.3 (0.2–0.6)	0.3 (0.1–0.5)
≥3500	45	61	0.3 (0.1–0.6)	0.3 (0.1–0.6)
			P<0.001	P<0.001
Height-for-age (*Z–scores*)				
≤−3	24	5	8.4 (2.5–28.3)	6.3 (1.7–21.5)
−2.9 to −2	35	22	5.1 (2.1–12.5)	6.0 (2.2–16.4)
−1.9 to −1	67	52	3.4 (1.7–6.8)	3.6 (1.7–7.4)
>−1	55	111	1.0 [d]	1.0 [e]
			P<0.001	P<0.001
Weight-for-age (*Z-scores*)				
≤−3	28	3	24.0 (6.1–94.6)	32.7 (6.3–168.4)
−2.9 to −2	50	19	12.7 (4.7–34.9)	18.6 (5.9–58.4)
−1.9 to −1	68	50	5.1 (2.5–10.6)	5.6 (2.5–12.4)
>−1	42	118	1.0 [d]	1.0 [e]
			P<0.001	P<0.001
Weight-for-length (*Z-scores*)				
≤−2	28	9	11.6 (3.6–37.2)	14.0 (4.0–48.5)
−1.9 to −1	62	19	7.2 (3.3–15.8)	8.4 (3.4–20.5)
>−1	87	162	1.0 [d]	1.0 [e]
			P<0.001	P<0.001

[a,b,c] See corresponding footnotes to Table 2.

[d] Adjusted for age.

[e] Adjusted for age and father's presence/education level.

because of the small numbers involved (11 twins among the cases and 5 among the controls).

Table 3 shows the main results for the anthropometric variables, all of which were strongly associated with the risk of dehydration. Children of low birth weight were about three times more likely to become dehydrated than other children. Also, children who were stunted, underweight, or wasted had a much greater risk than those whose nutritional status was adequate. Since weight (and therefore weight-for-age and weight-for-length) is likely to have been reduced as a consequence of dehydration, cases were only weighed after complete dehydration.

The weights of cases might have been reduced because of loss of body mass during episodes of diarrhoea, which were presumably more severe than those of control children. To simulate this we added 10% to the crude weights of the cases but not to those of the controls. This adjustment resulted in a three- to fourfold reduction in the odds ratios associated with underweight and with wasting. Both these variables remained significant; however, the effect of low weight-for-age was at least as great as that of stunting.

We also investigated whether the effect of birth weight was mediated by nutritional status. When both weight-for-age and birth weight were included in the regression model, the effect of birth weight was no longer significant; the risk of low-birth-weight children being dehydrated was then only 1.2 times greater than the risk among other children.

The type of milk consumed by children before their diarrhoeal episode was also strongly associated with the risk of dehydration (Table 4). Children who were not breast-fed were three times more likely to become dehydrated than those who received breast but no other milk (Fig. 1).

The feeding mode or type of diet—which took into account not only the type of milk but also other weaning foods—was also strongly associated with the risk of dehydration. The children at highest risk were those who received unsupplemented non-breast milk, particularly powdered milk, while those at lowest risk received breast milk plus solids. Because

Table 4: **Prognostic factors (dietary variables) for diarrhoea-associated dehydration, Porto Alegre, Brazil, 1988**

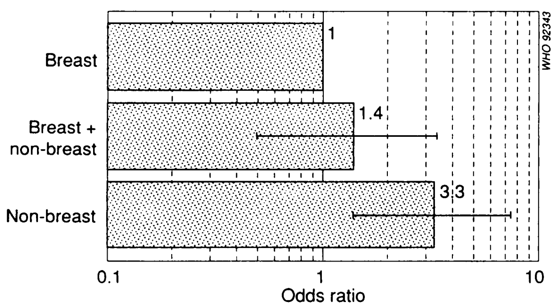
Variable	No. of cases	No. of controls	Odds ratio	
			Crude or age-adjusted	Adjusted also for father's presence/education
Type of milk				
Breast	17	29	1.0 [a]	1.0 [b]
Breast + cow's	25	38	1.3 (0.5–3.1) [c]	1.3 (0.5–3.3)
Breast + powdered	7	6	0.8 (0.2–4.1)	0.9 (0.2–4.8)
Cow's	106	108	2.2 (1.01–4.9)	2.5 (1.1–6.0)
Powdered	26	9	9.4 (2.7–32.4)	10.3 (2.6–40.1)
			$P = 0.002$	$P = 0.002$
Breast	17	29	1.0 [a]	1.0 [b]
Breast + non-breast	32	44	1.3 (0.6–3.2)	1.4 (0.5–3.4)
Non-breast	132	117	2.8 (1.3–6.1)	3.3 (1.4–7.5)
			$P = 0.008$	$P = 0.003$
Feeding mode				
Breast milk [d]	10	8	1.0 [a]	1.0 [b]
Breast + non-breast milk	22	10	1.3 (0.3–5.8)	1.2 (0.2–6.0)
Breast + solids	6	21	0.2 (0.03–1.1)	0.2 (0.03–1.2)
Breast + non-breast + solids	11	34	0.3 (0.06–1.3)	0.3 (0.05–1.4)
Non-breast milk	60	16	2.6 (0.7–9.1)	2.7 (0.7–10.4)
Non-breast + solids or solids only	75	101	0.8 (0.2–3.2)	0.9 (0.2–4.1)
			$P<0.001$	$P<0.001$

[a] Adjusted for age.
[b] Adjusted for age and father's presence/education level.
[c] Figures in parentheses are the 95% confidence intervals.
[d] Includes also children who received teas or water.

of the small number of children in some of these categories, however, the confidence intervals were very wide.

Table 1 shows also the effects of environmental variables. There was a clear increase in risk with the number of other under-5-year-olds (in addition to the index child) in the household—the risk being more than twice as great (adjusted odds ratio (OR) = 2.3; 95% confidence interval (CI) = 1.1–4.9) in homes with two or more other under-5-year-olds than in those with none. There were no associations with the number of children aged 5–12 years or with the presence of grandparents in the home. The total number of persons in the household was associated with the risk of dehydration, but no linear trend was observed, the highest risk being for families with 4–5 members (adjusted OR = 1.2; CI = 1.2–4.5, relative to families with <4 members). This association persisted after adjustment for the number of under-5-year-olds.

Fig. 1. **Risk of diarrhoea-associated dehydration (adjusted for age and father's educational level), according to the type of milk consumed** (bars are the 95% confidence intervals).



There was no association between the risk of dehydration and the number of rooms and bedrooms in the house, ownership of a refrigerator, availability of piped water, source of water, or type of latrine. Children living in shacks were at a greater risk than those living in well-built homes, but after adjustment for presence/schooling of the father the difference was not significant. The state of cleanliness of the house was strongly associated with the risk of dehydration, but no such information was available for 40% of the cases whose mothers were interviewed in hospital (their respective controls were also excluded

Table 5: **Prognostic factors (morbidity) for diarrhoea-associated previous dehydration, Porto Alegre, Brazil, 1988**

Variable	No. of cases	No. of controls	Odds ratio: Crude or age-adjusted	Odds ratio: Adjusted also for father's presence/education
Previous hospitalizations				
0	116	145	1.0 [a]	1.0 [b]
≥1	75	47	2.1 (1.2–3.5)[c] $P = 0.004$	2.0 (1.15–3.4) $P = 0.01$
Medicines used in previous 2 weeks				
No	48	80	1.0 [a]	1.0 [b]
Yes	142	111	2.2 (1.3–3.6) $P = 0.002$	2.3 (1.3–4.1) $P = 0.002$
Antibiotics used in previous 2 weeks				
No	171	170	1.0 [a]	
Yes	21	22	1.3 (0.6–2.7) $P = 0.5$	

[a] Adjusted for age.
[b] Adjusted for age and father's presence/education level.
[c] Figures in parentheses are 95% confidence intervals.

from the analyses). The adjusted odds ratio for "dirty" relative to "clean" households was 3.3 (95% CI = 1.3–8.1).

Variables related to utilization of health services were also investigated (see Table 1). The risk of dehydration was twice as great for children whose mothers had received no antenatal care, but this differential decreased after adjustment for presence/schooling of the father. There was no effect for the number of attendances at antenatal clinics or for the gestational age at which antenatal care was started. The place of birth was not significantly associated with the risk of dehydration, but the number of births at home was very small.

Children who had not received diphtheria–pertussis–tetanus (DPT) or poliomyelitis vaccines were at much higher risk than those who had received three or more doses (age- and confounder-adjusted OR = 3.8, 95% CI = 1.3–11.2 for DPT; OR = 7.4, 95% CI = 2.2–25.1 for poliomyelitis), but measles vaccination (which usually occurs at 9–12 months of age, after which dehydration is rare) had no significant effect. The risk of dehydration decreased as the reported number of weighings in health services increased, but this association was not significant after controlling for the presence/schooling of the father.

The association between previous morbidity and the risk of dehydration in the episode studied in the present study is shown in Tables 1 and 5. Children who had previously been admitted to hospital were 2–3 times more likely to become dehydrated than those who had never been hospitalized. Also, children who had taken any medicine in the 2 weeks preceding onset of the diarrhoea episode were at greater risk, but this did not hold for the small number of children who had received antibiotics.

Table 6: **Sensitivity, specificity and positive predictive value of selected prognostic factors for dehydration among children with diarrhoea**

Variable and cut-off value	Sensitivity (%)	Specificity (%)	Positive predictive value (%) [a]
Age (months) [b]			
<2	18	96	12
<4	46	79	5
Birth weight			
<2500 g	24	91	8
Length-for-age			
<–3 *Z*-scores	13	97	13
<–2 *Z*-scores	33	86	5
Weight-for-age			
<–3 *Z*-scores	15	98	22
<–2 *Z*-scores	41	88	8
Weight-for-length			
<–2 *Z*-scores	16	95	9
Breast-feeding			
None	73	38	3
None/mixed	91	15	2
Birth interval			
<18 months	27	85	6

[a] Assuming that 3% of diarrhoea episodes will lead to dehydration.
[b] Analysis restricted to children under 1 year of age.

Table 6 shows the sensitivity, specificity and positive predictive value of those variables that were most strongly (P <0.001) associated with the risk of dehydration as a consequence of diarrhoea. These included the child's age, birth weight and other anthropometric indicators, birth interval, and type of feeding. In general, sensitivities and positive predictive values were low and specificities high.

Discussion

The case–control approach, despite its ethical and logistic advantage over prospective designs for evaluating prognostic factors for diarrhoea-associated dehydration among children, has drawbacks that must be taken into consideration in interpreting the results. One limitation is recall bias; the mothers of children with dehydration may have had a better recall of the events preceding the episode than those of children with mild diarrhoea. This may have influenced, for example, the report of recent use of medicinal drugs. Also, the presence of the illness may have interfered with the measurement of the prognostic factor being studied (reverse causality). This applies to child's weight, which decreases as a result of dehydration. We attempted to avoid this bias by weighing children after they had been completely rehydrated, and also by simulating a 10% weight loss arising from the episode; a strong effect for low weight-for-age was still present after this adjustment.

A third source of bias is overmatching because the controls and cases both came from the same neighbourhoods. The main interest of the study was not socioeconomic factors — whose strong association with diarrhoeal incidence, severity, and mortality is well documented (*8*) — but other prognostic factors, which are potentially modifiable by health sector interventions. If proper matched analysis is carried out — as was the case in the present study — overmatching should not affect the estimates of the odds ratios but only reduce their precision (*6*).

The main results of the study are summarized in Table 1. The following variables were significantly associated with an increased risk of dehydration: absence of the father in the home; low paternal education; young age; maternal age 25–29 years or under 20 years; mother of mixed (mulatto) race; high birth order; short birth interval; low birth weight; stunting, underweight and wasting; lack of breast-feeding; presence of other under-5-year-olds in the home; families with 4–5 members; lack of antenatal care; less than three doses of DPT or poliomyelitis vaccine; previous admission to hospital; use of medicines in the previous fortnight; and living in an unclean home. Particularly strong (P <0.001) associations were found for the child's age, birth weight and other anthropometric indicators, birth interval, and feeding mode.

Very young children are at the highest risk of dehydration, being reflected in the higher case-fatality ratio for diarrhoeal diseases among infants (*1*), which has been linked to their smaller body size (*9*). This also explains the association between malnutrition and the risk of dehydration.

Since birth weight is a strong predictor of nutritional status in young children (*10*), its effect is likely to be mediated through malnutrition, as evidenced by its reduced effect after adjustment for weight-for-age.

The greater risk of dehydration among children born after a short birth interval can be explained in at least the following ways: firstly, short birth intervals are associated with low birth weight and malnutrition (*11*); secondly, mothers with more than one small child may be less likely to cope adequately with an episode of diarrhoea – or even less likely to recognize it; and thirdly, specific pathogens may be more likely to be present in households with several young children and also more likely to cause dehydration. The association between dehydration and the number of under-5-year-olds accords also with the above-mentioned finding for birth-spacing.

The effects of breast-feeding on the risk of dehydration strengthen the evidence that mother's milk influences not only the incidence but also the severity of the diarrhoea episodes (*12, 13*).

The lack of association between environmental variables — except those related to the number of young children — and the risk of dehydration suggests that such variables affect the incidence of the episode (through greater exposure) but not its severity. Our analysis of these variables may also have been affected by overmatching.

The associations between health care variables (antenatal care and immunization status) probably reflect greater concern about child health and care, as well as better access to health services and therefore to early appropriate management. Also, these variables may indirectly affect the risk of dehydration, e.g., antenatal care, resulting in higher birth weight and therefore in lower risk.

The analysis of the sensitivity, specificity, and positive predictive value of the main prognostic factors (Table 6) permits comparison with the performance of different signs and symptoms in predicting diarrhoea-associated dehydration. We have previously reported that in this respect fever had a sensitivity of 60% and a specificity of 78%, whereas the comparable values for vomiting were 58% and 78%. The child's weight had a sensitivity of 58% and a specificity of 82% at a 6-kg cut-off, and of 75% and 68%, respectively, at a 7-kg cut-off.[b] These prognostic factors were therefore better indicators than those considered in the present analysis, particularly in terms of their sensitivity.

Nevertheless, our results suggest that current efforts towards promotion of breast-feeding, prevention and treatment of malnutrition, and birth-spacing — in addition to their effects on several other paediatric conditions — may also contribute to the prevention of dehydration as a consequence of diarrhoea.

Résumé

L'allaitement au sein, l'état nutritionnel et autres facteurs de pronostic de la déshydratation chez des enfants en bas âge atteints de diarrhée, au Brésil

La possibilité d'identifier précocement les enfants exposés à un haut risque de déshydratation associée à la diarrhée serait d'une grande utilité pour les agents de soins de santé dans les pays en développement. Afin de recenser les facteurs de pronostic d'une déshydratation entraînant un risque de décès, nous avons exécuté une étude cas-témoins sur des enfants de moins de deux ans à Porto Alegre (Brésil). Les sujets de l'étude étaient 192 enfants hospitalisés avec une déshydratation modérée ou grave, les témoins étant des enfants d'âge correspondant, vivant dans le voisinage et ayant subi un épisode de diarrhée non déshydratante au cours de la semaine précédant l'interrogatoire.

Après correction de l'âge et d'autres variables confondantes, nous avons constaté que les variables ci-après étaient associées de manière significative à un risque accru de déshydratation: père absent du foyer, faible niveau d'instruction du père, enfant jeune, mère âgée de 25–29 ans ou de moins de 20 ans, mère métisse, rang de naissance élevé, faible espacement des naissances, faible poids à la naissance, retard de croissance, poids insuffisant et maigreur, pas d'allaitement au sein, présence d'autres enfants de moins de cinq ans au foyer, famille de 4–5 membres, défaut de soins prénatals, administration de moins de 3 doses de vaccination diphtérie-tétanos-coqueluche ou antipoliomyélitique, hospitalisations antérieures, absorption de médicaments au cours des 15 jours précédant l'épisode et malpropreté de l'habitation. Les associations ont été particulièrement fortes (P <0,001) en ce qui concerne l'âge de l'enfant, le poids de naissance et autres indicateurs anthropométriques, l'espacement des naissances et le mode d'alimentation. Toutefois, en termes de sensibilité et de spécificité, ces facteurs de pronostic se sont révélés moins efficaces que les symptômes précoces en ce qui concerne l'issue de l'épisode diarrhéique.

[b] **Victora, C.G. et al.** *Small body size as a simple indicator of the risk of dehydration among young children with diarrhea.* Unpublished document.

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